Crop Production Clinics

IRRIGATION WELL WATER: ESSENTIAL NUTRIENTS, LIME AND OTHER PROPERTIES

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Highlights

- Water of 642 wells was sampled in 2020
- Irrigation supply in 10 ac-in is > removal in 200 bu/ac of corn grain for:
  - >90% of wells for liming effect;
  - >50% for Ca, Mg, S, and Cl;
  - >20% for K, Mn and Mo;
  - little P, Zn, Cu, Fe, and Mo
- Most wells have < 4.4 ppm NO_3-N but 25% have >10 ppm
- Relatively low nutrient & lime supply in Sandhills but high for wells of <100 ft depth

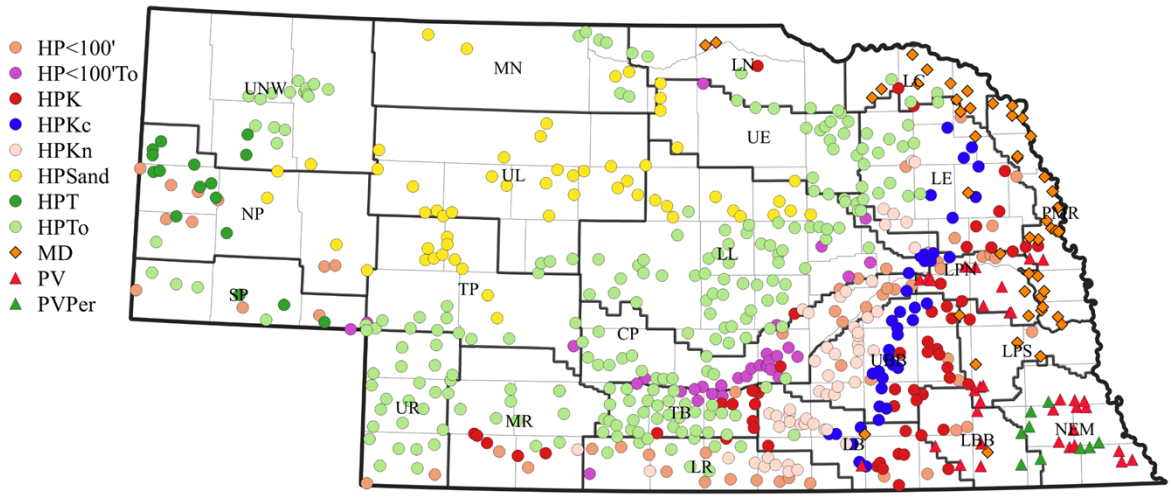
This is for interpretation ofnb the WB images.

Highlights

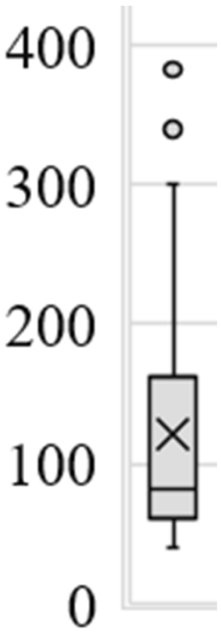
- Salinity and sodium of little concern **for the sampled wells**
- Much variation between and within NRD
  - Test water for individual or groups of similar wells to optimize nutrient & soil management
  - Complement water information with regular soil testing and the use of recommended nutrient management guidelines.

This is for interpretation ofnb the WB images.

Sampled wells: 11 aquifers-geology-depth categories



YOU MAY WANT TO SKIP THIS SLIDE FOR BREVITY AS THE SUBSEQENT SLIDES FOCUS ON REGIONAL AND NRD RESULTS. Aquifer, geology and depth of well differences accounted for much variation in water properties. In the map showing the distribution of wells, aquifers are designed as HP (High Plains), MD (Maha-Dakota) and PV (Paleovalley). Depth of wells are as <100' or deeper. Geology is as To (Miocene), T as pre-Miocene in western NE (Arikaree and White River formations); K, Kc, Kn are various Cretaceous and Pennsylvania formations in the eastern 1/3 and southern NE; Per is of the Permian age (southeastern). HPSand are wells in the Sandhills which is part of HPTo but treated as a separate group of wells.

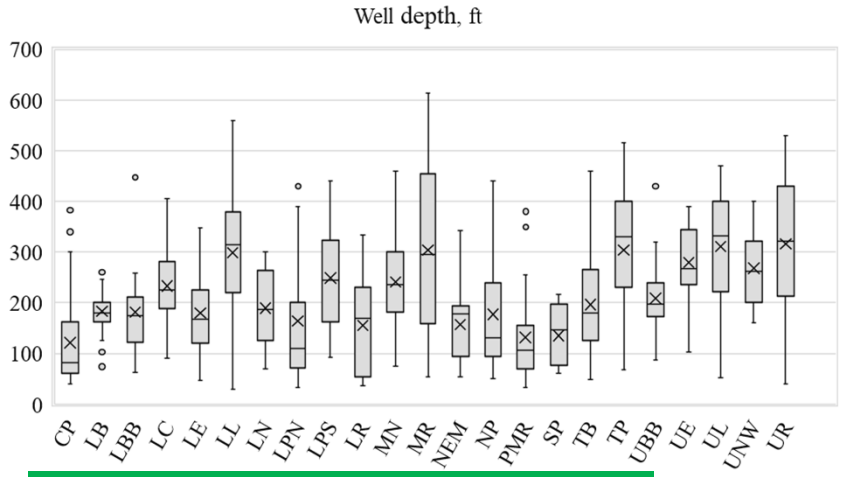


Whisker-box diagrams

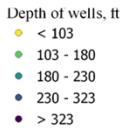
1. 50% intermediate observations in box
2. 25% each in above and below whiskers
3. X is the average
4. Horizontal line in box it the median; 50% above and 50% below
5. Circles are considered outliers for the NRD

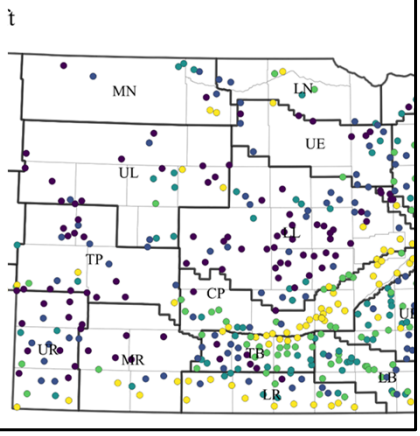
This is for interpretation of the WB images. WB generally report in lb per 10 ac-in to be interpreted relative to removal in 200 bu corn grain harvest. The maps report concentrations with legend in lower left.

Well depth (central)



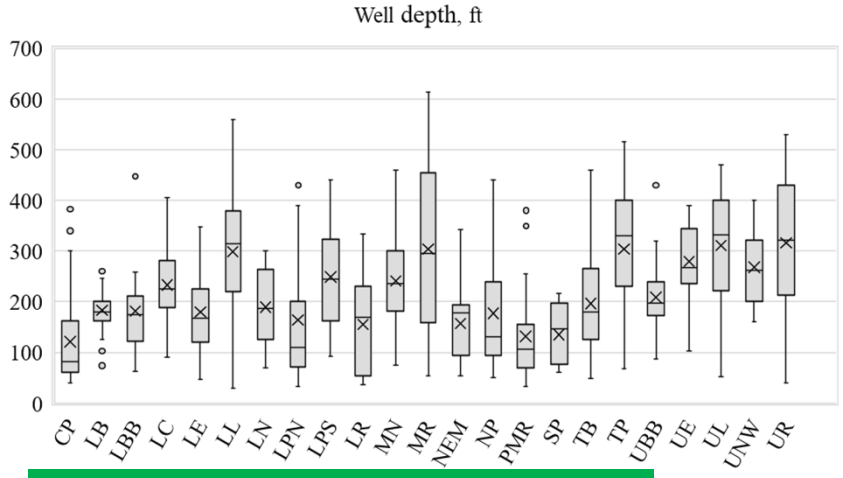
The shallow wells (yellow) were mostly in alluvial aquifers of the Platte & Republican, e.g CP & southern LR. These often have high nutrient concentrations.

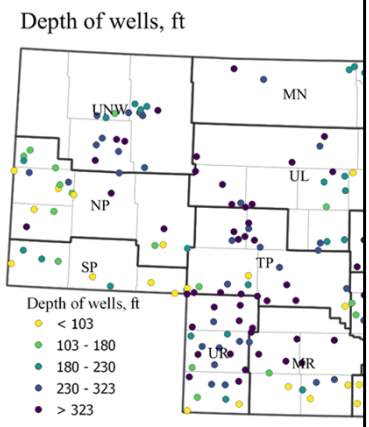




The WB images have NRD on x-axis and values indicatd by the subtitle on the y-axis. The *Natural Resources Districts (NRD) abbreviations*: CP, Central Platte; LB, Little Blue; LBB, Lower Big Blue; LC, Lewis and Clark; LE, Lower Elkhorn; LL, Lower Loup; LN, Lower Niobrara; LPN, Lower Platte North; LPS, Lower Platte South; LR, Lower Republican; MN, Middle Niobrara; MR, Middle Republican; NEM, Nemaha; NP, North Platte; PMR, Papio Missouri River; SP, South Platte; TB, Tri Basin; TP, Twin Platte; UBB, Upper Big Blue; UE, Upper Elkhorn; UL, Upper Loup; UNW, Upper Niobrara White; UR, Upper Republican.

Well depth (western)





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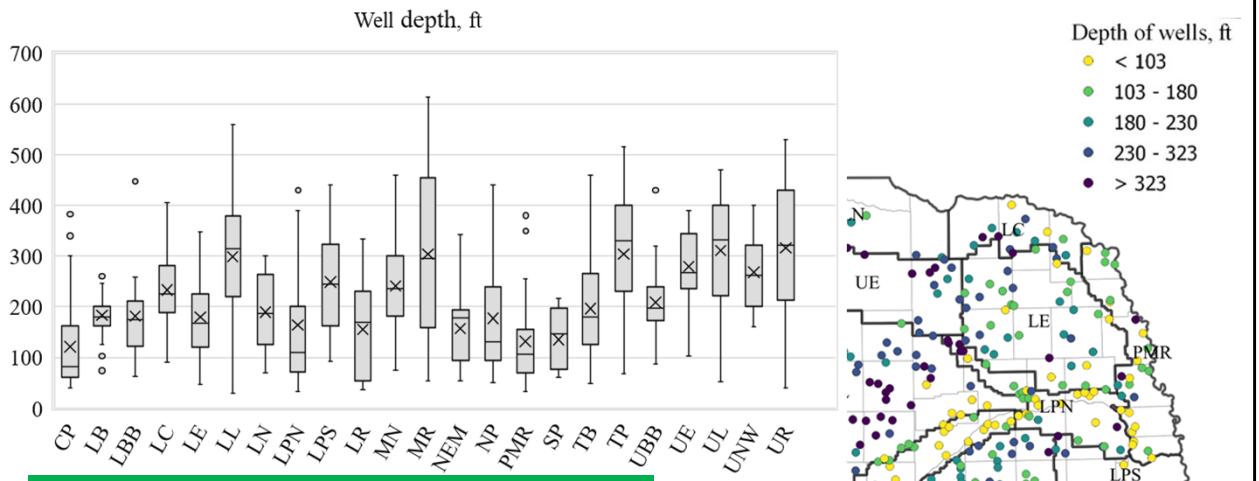
Well depth (eastern)



The shallow wells (yellow) were mostly in alluvial aquifers of the Platte and Elkhorn Rivers, e.g CP & LPN. These often have high nutrient concentrations.

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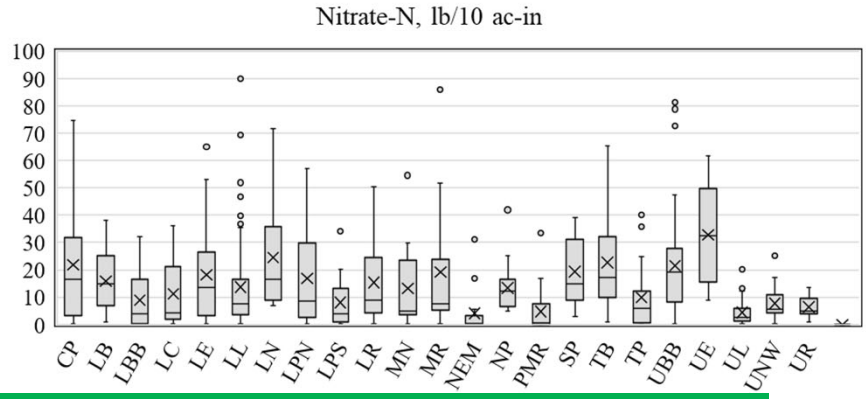
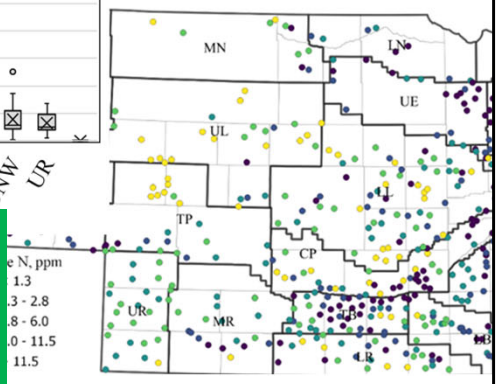
Nitrate-N (very little NH_4-N), central



ppm x 2.265 = lb/10 ac-in

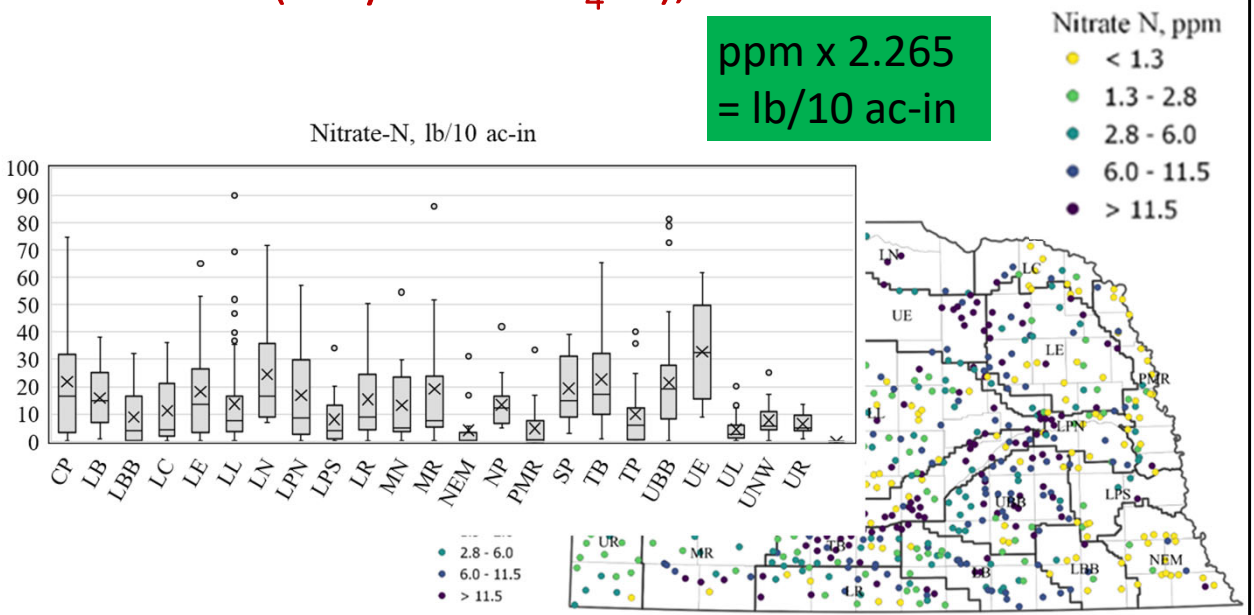


The Sandhills wells mostly have low NO_3-N due to relative newness, depth, high recharge and, on average, three low-transmissivity layers of 15" average thickness overly the pumping zone that hinder movement of contaminants to the pumping zone.

In WB, nutrient rates are as lb in 10 ac-in which= ppm x 2.265 realizing that annual irrigation is typically <10 ac-in in E NE and > in W NE. . NRDs had varying levels of nitrate concentration but on average relatively high for CP, UE and LN, and low for Sandhills wells.

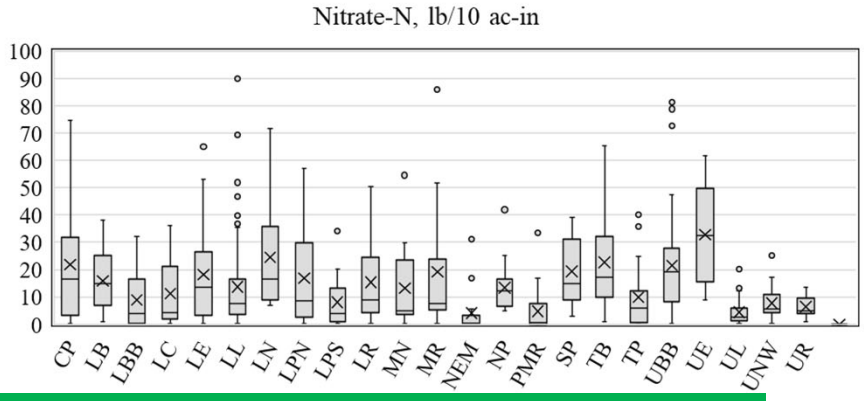
Nitrate-N (very little NH_4-N), eastern

ppm x 2.265
= lb/10 ac-in

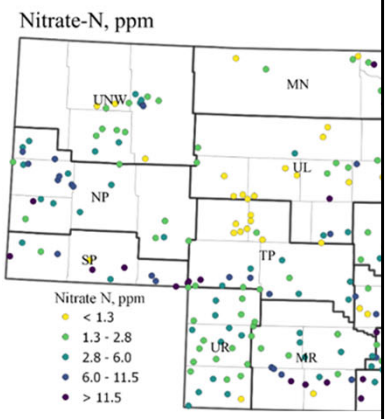


In WB, nutrient rates are as lb in 10 ac-in which= ppm x 2.265 realizing that annual irrigation is typically <10 ac-in in E NE and > in W NE. . NRDs had varying levels of nitrate concentration but on average relatively high for eastern UE and low for PMR, NEM and LPS.

Nitrate-N (very little NH_4-N), western

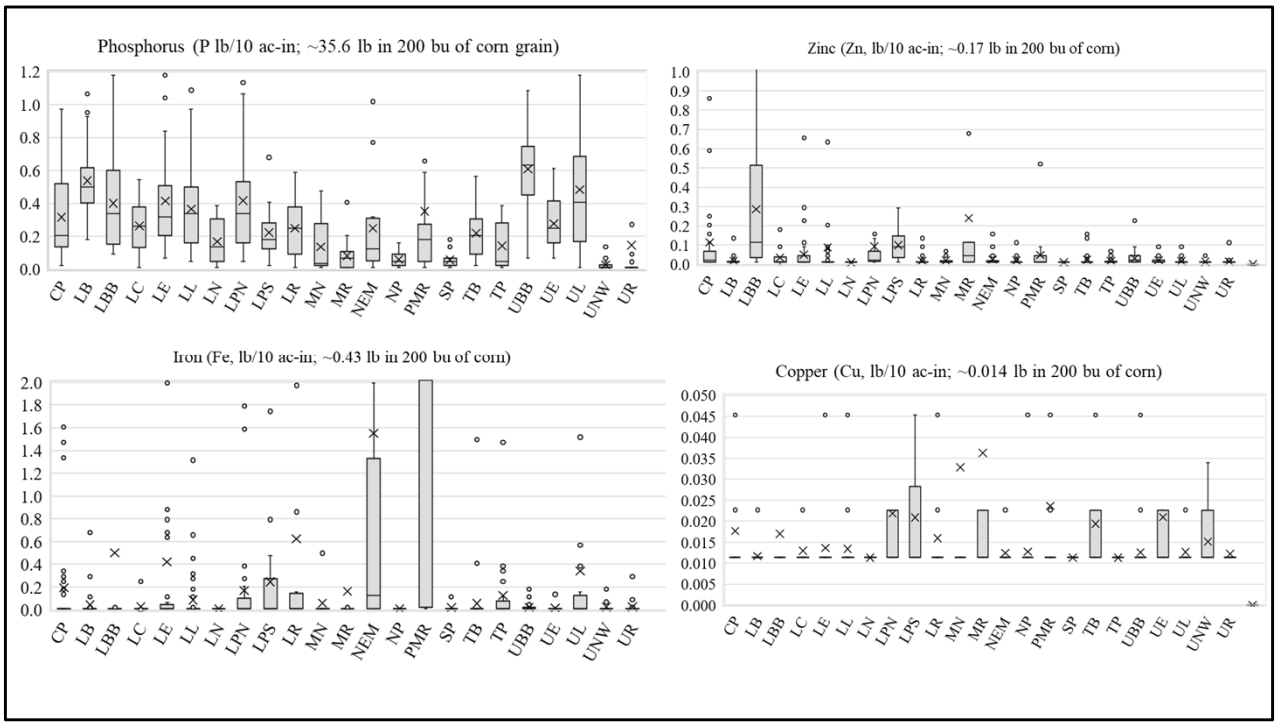


ppm x 2.265 = lb/10 ac-in

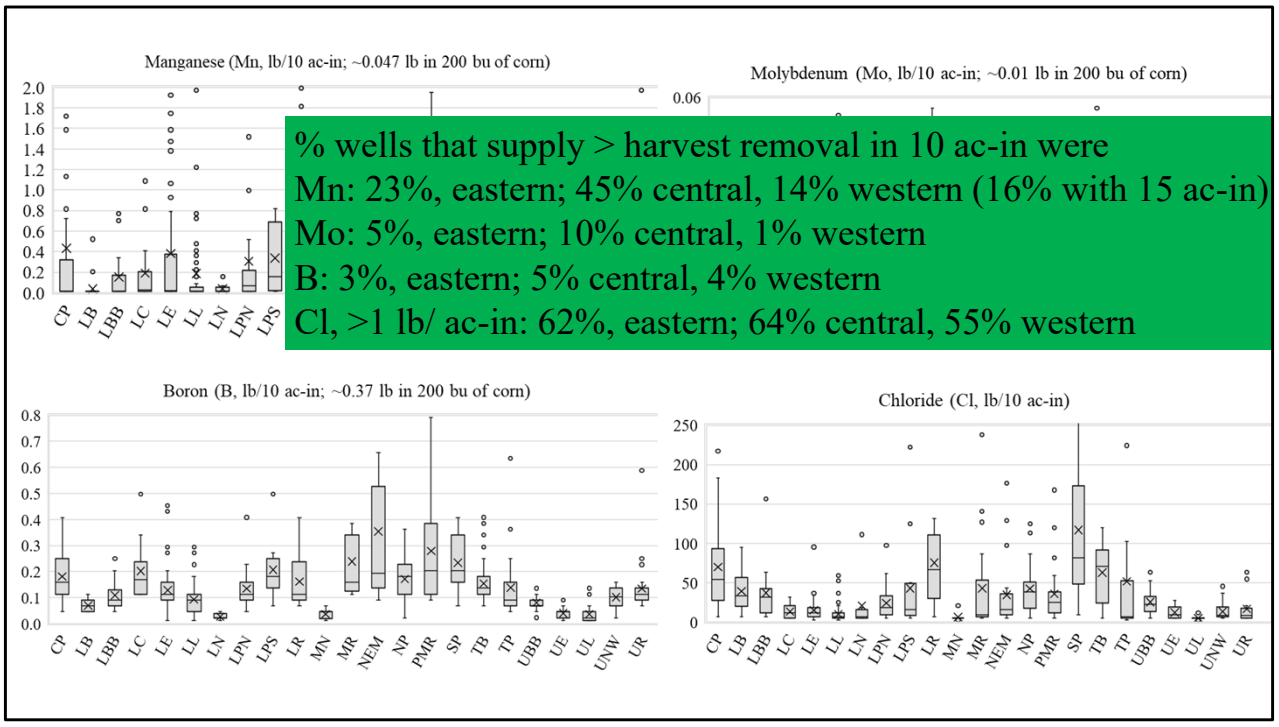


The Sandhills wells mostly have low NO3-N due to relative newness, depth, high recharge and, on average, three low-transmissivity layers of 15” average thickness overly the pumping zone that hinder movement of contaminants to the pumping zone.

In WB, nutrient rates are as lb in 10 ac-in which= ppm x 2.265. NRDs had varying levels of nitrate concentration but on average relatively high for NP and SP and low for Sandhills wells.

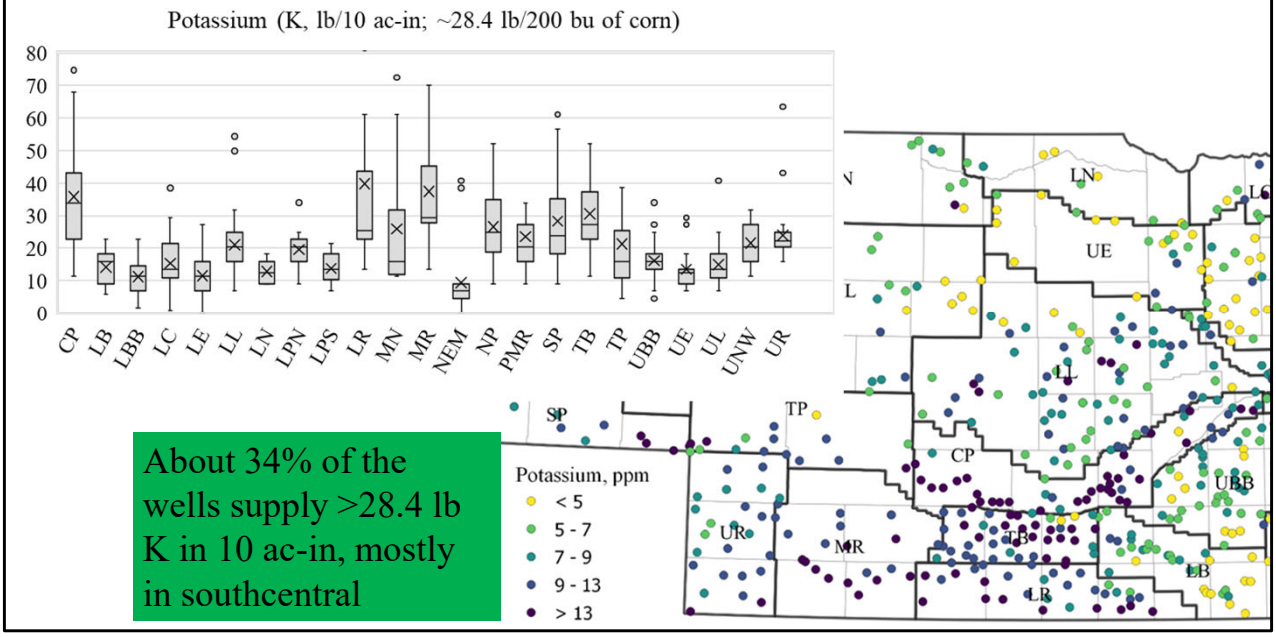


The WB can be interpreted according to nutrient removal in 200-bu corn grain harvest realizing that there are situations for more and less yield, of grain plus residue harvest, and of crop rotation that affect actual average annual removal. Irrigation water often had P, Zn Fe and Cu concentrations below the reliable measurement level and irrigation supplies little relative to crop harvest removal but is often of significance in slowing the depletion of available soil nutrients. However, there is much variation between wells, even in NRDs, suggesting value in testing the water. Wells in LBB often supply much Zn and wells in NEM and PMR of eastern NE often supply much Fe, but even with these NRD most wells supply less than removal especially considering that annual irrigation is < 10 ac-in in these NRD.

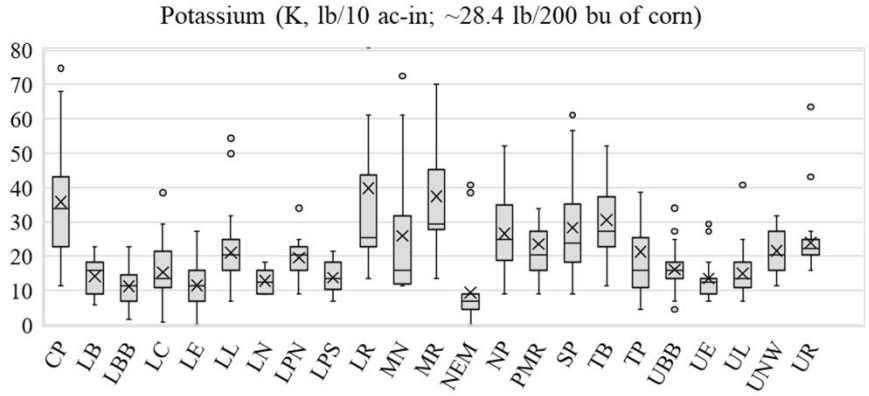


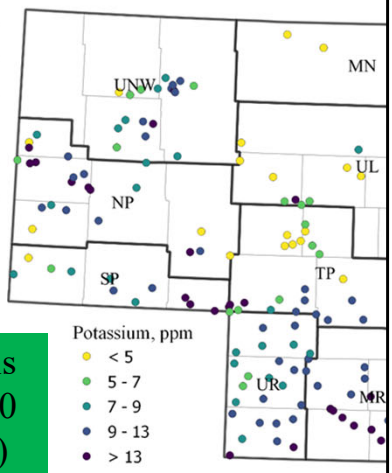
I do not have a good estimate of Cl concentration in corn grain. Therefore Cl is >1 lb/ ac-in in green box; KSU recommends application of 10-20 lb/ac Cl when soil test indicates low availability.

Potassium, central



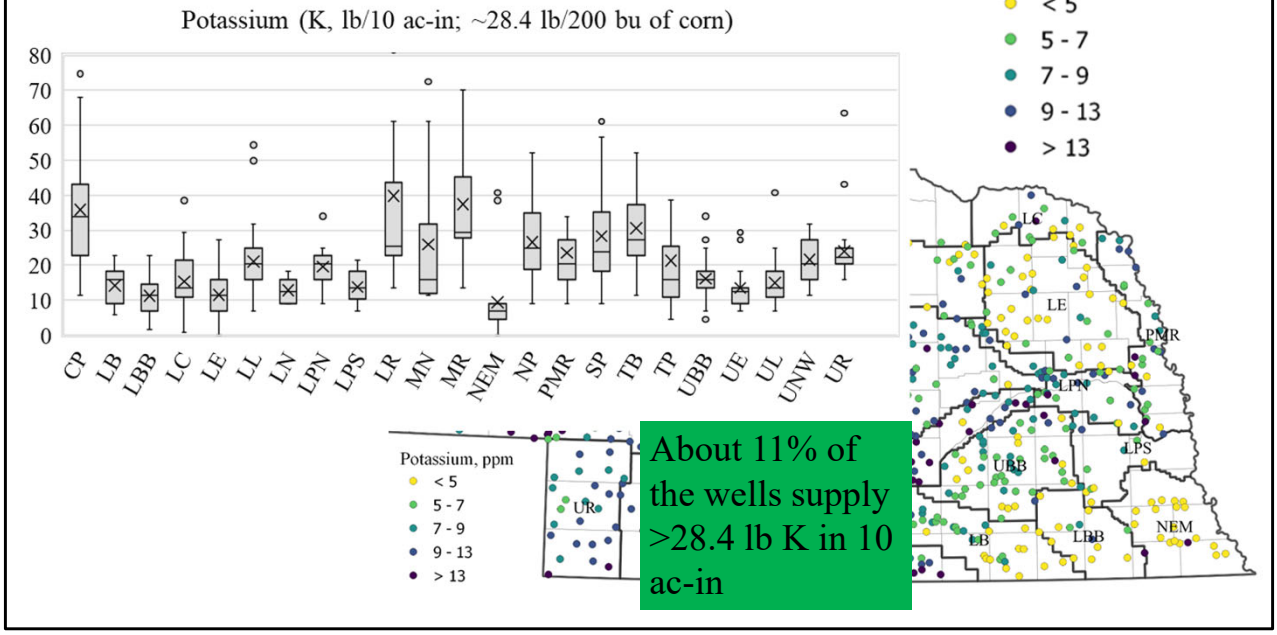
Potassium, western





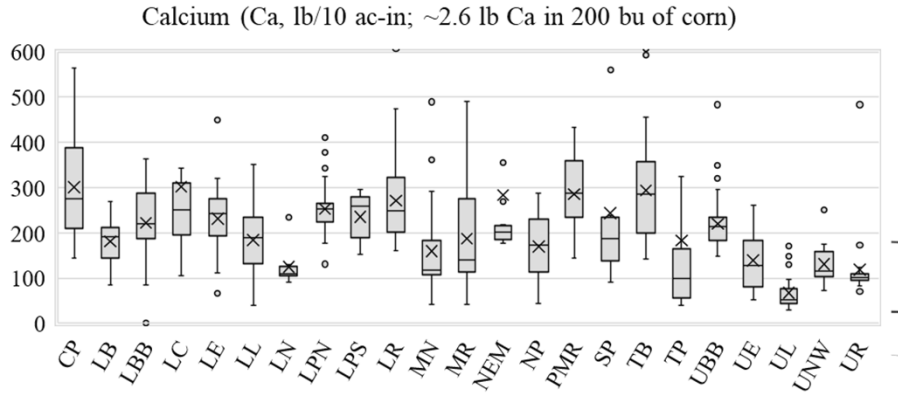
About 35% of the wells supply >28.4 lb K in 10 ac-in (64% in 15 ac-in)

Potassium, eastern

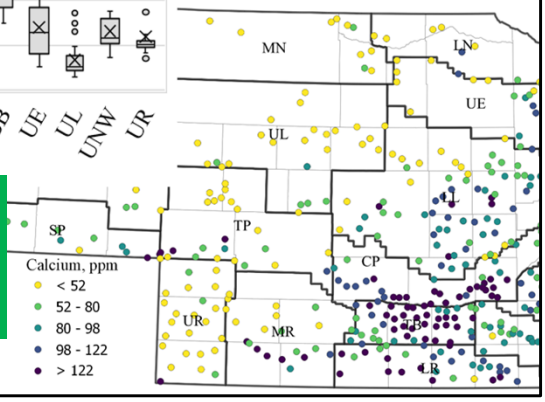


About 11% of the wells supply >28.4 lb K in 10 ac-in

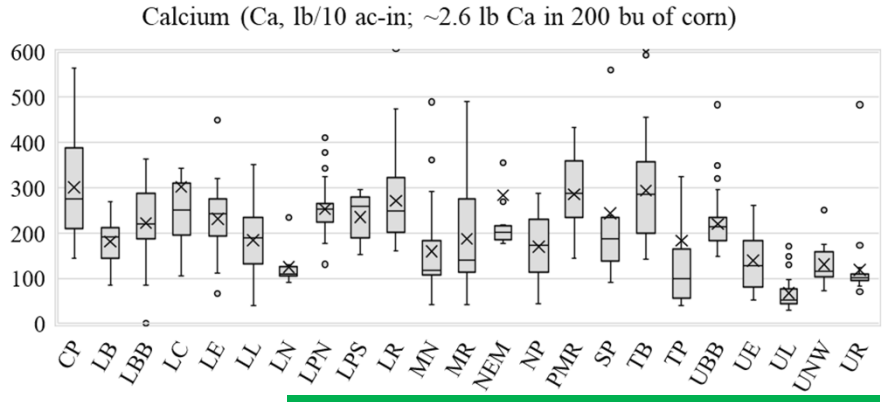
Calcium, central

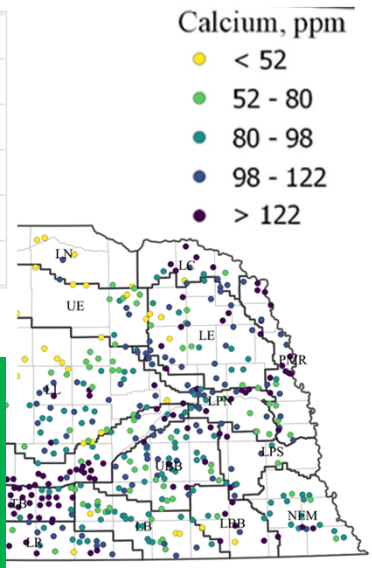


Applied Ca in the Sandhills can be valuable for prevention of Al toxicity associated with low soil pH. The Ca is in solution and moves down to displace AL which is leached out.



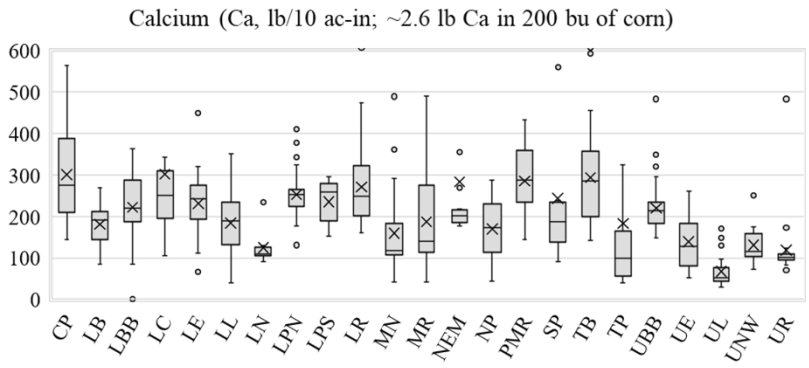
Calcium, eastern





Applied Ca in the Sandhills can be valuable for prevention of Al toxicity associated with low soil pH. The Ca is in solution and moves down to displace AL which is leached out.

Calcium, western



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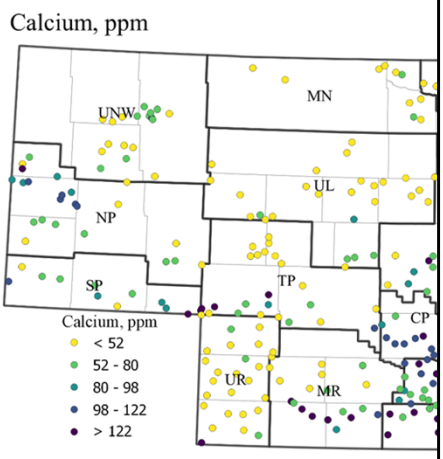
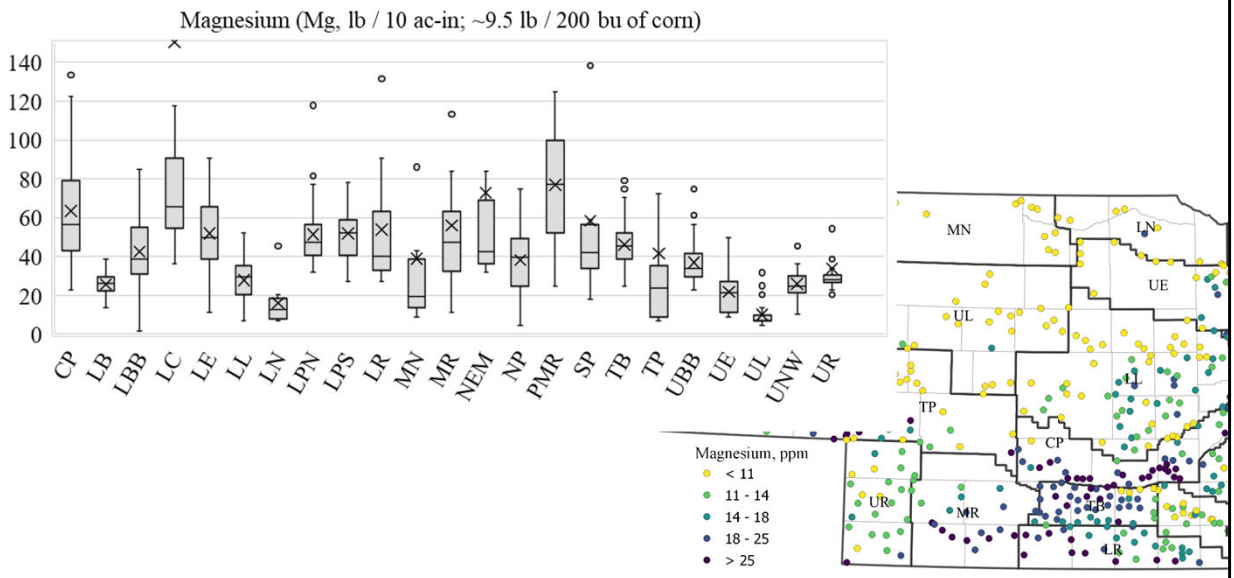
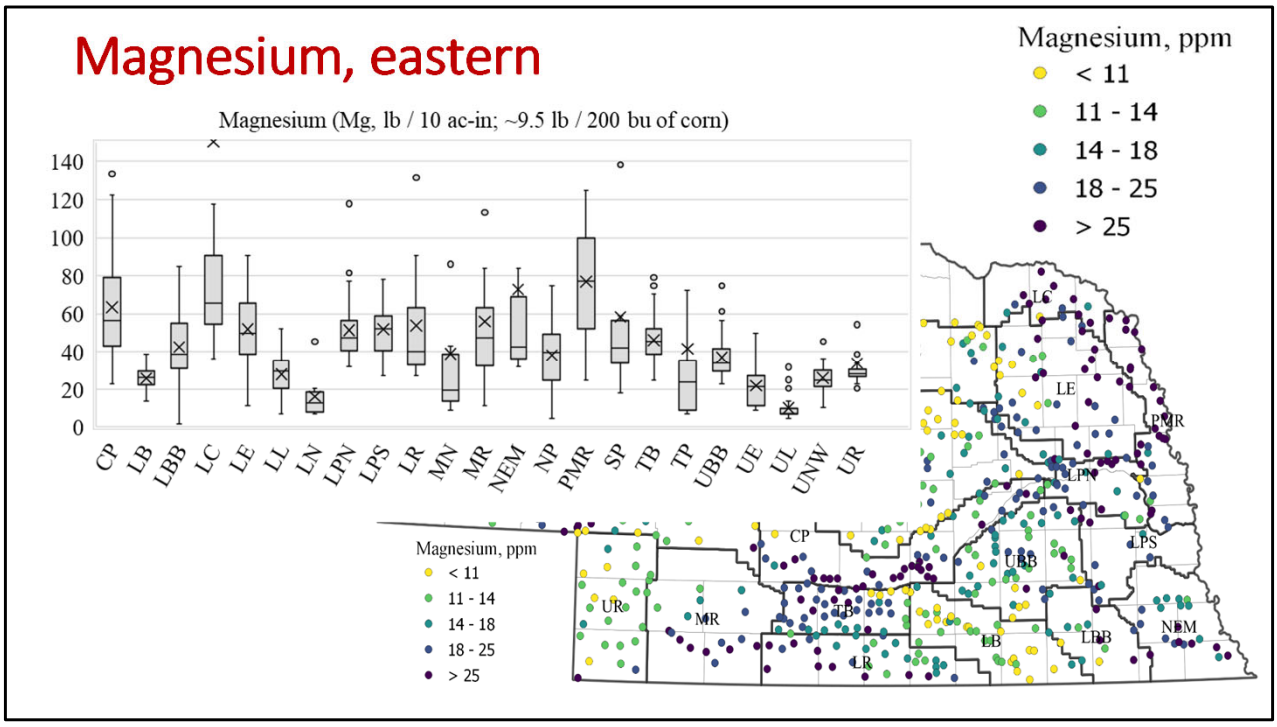


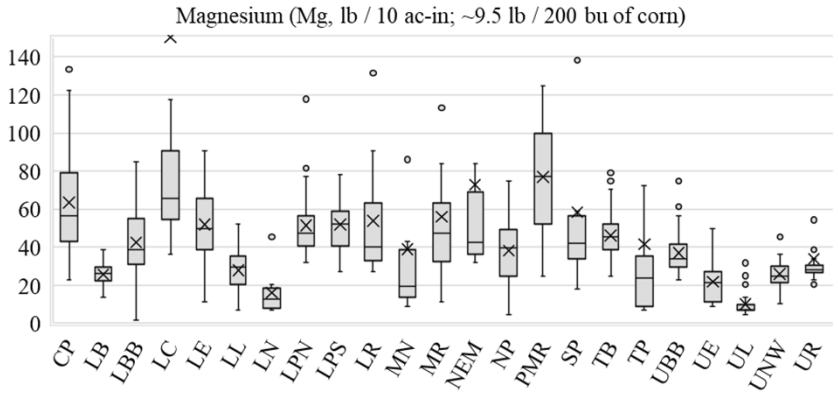
Magnesium, central

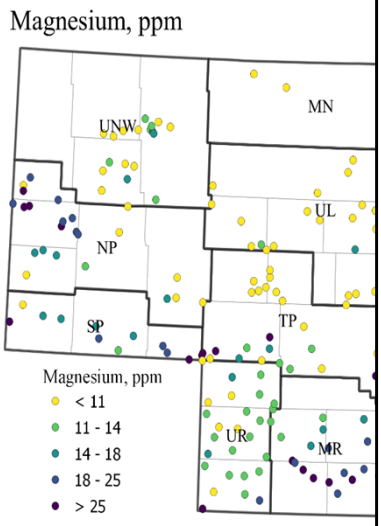


Magnesium, eastern

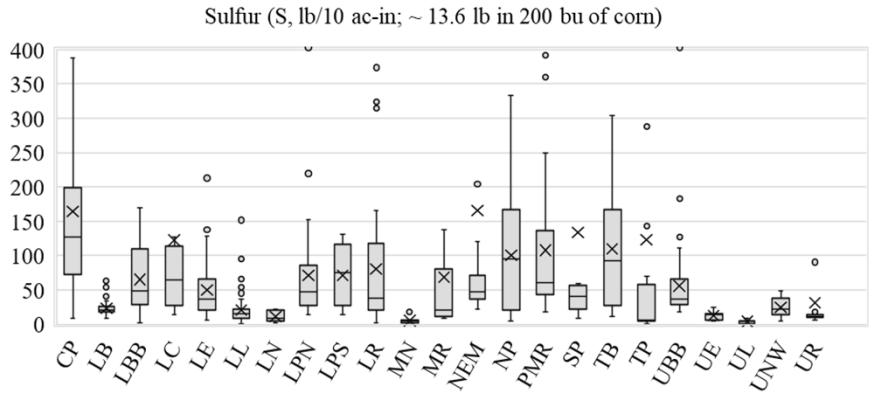


Magnesium, western

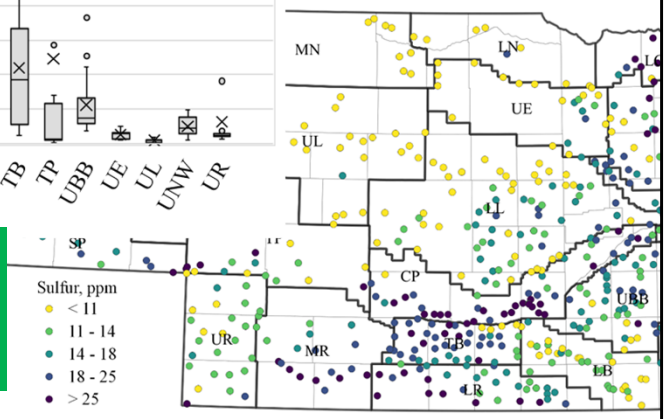




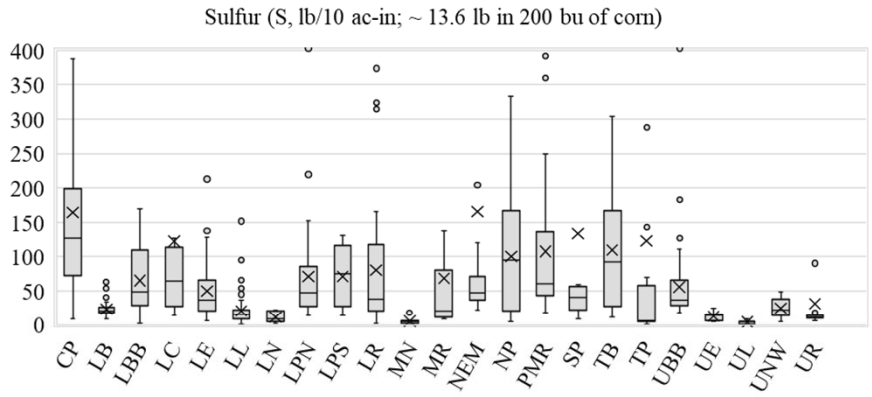
Sulfur, central

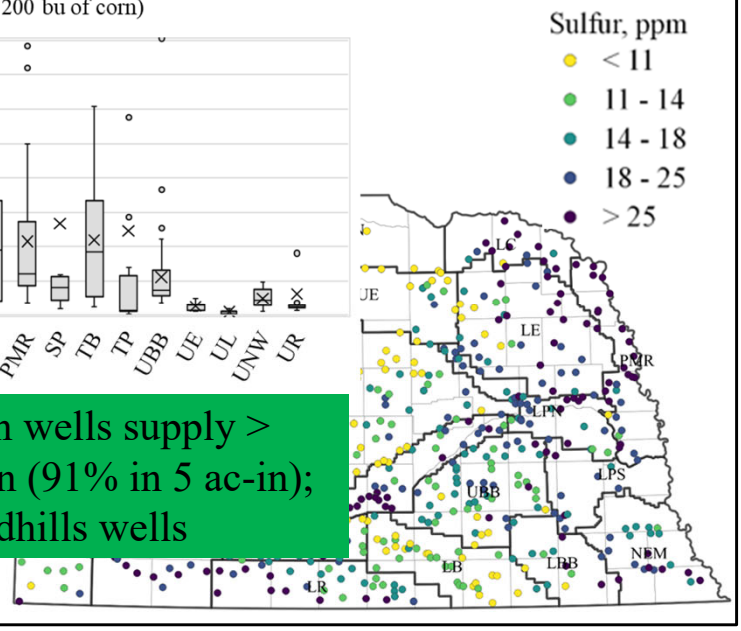


~68% of the Central wells supply > 13.6 lb S in 10 ac-in; less supply for Sandhills wells



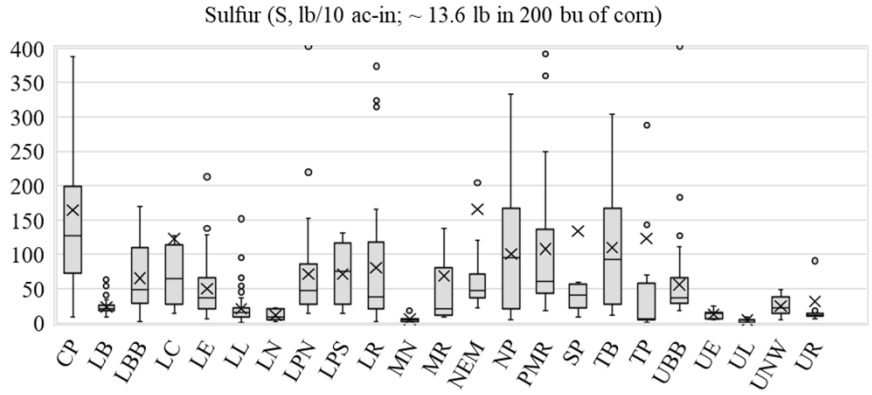
Sulfur, eastern



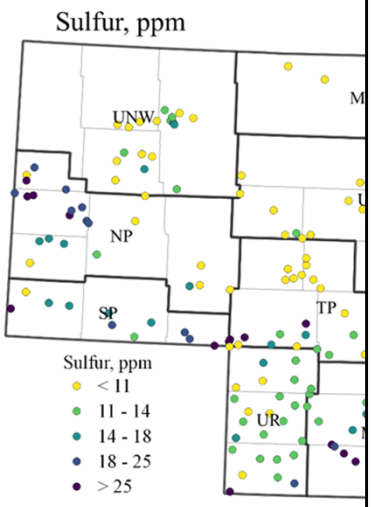


~95% of the eastern wells supply > 13.6 lb S in 10 ac-in (91% in 5 ac-in); less supply for Sandhills wells

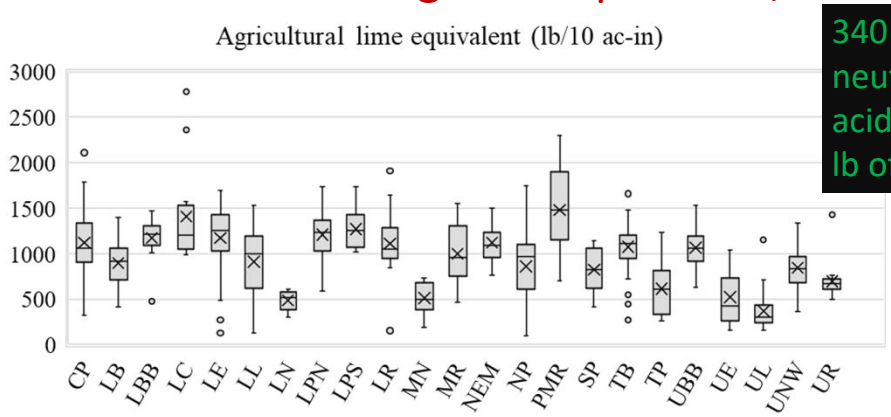
Sulfur, western



~58% of the western wells supply > 13.6 lb S in 10 ac-in (75% in 15 ac-in); less supply for Sandhills wells

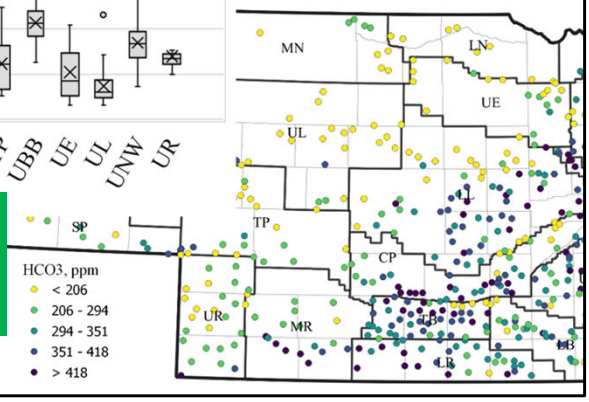


Bicarbonate and ag lime equivalent, central

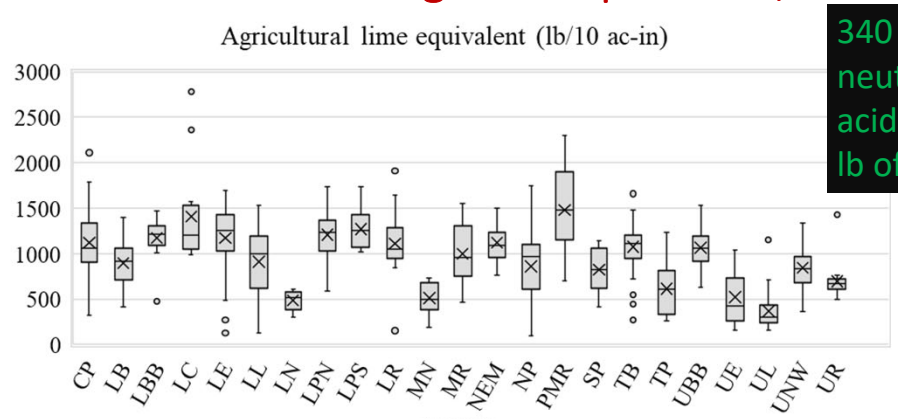


340 lb of agricultural lime neutralizes the acidification effect of 200 lb of fertilizer-N.

The liming effect of 10 ac-in was >340 lb ag lime for 72% of the wells and nearly all wells outside the Sandhills.

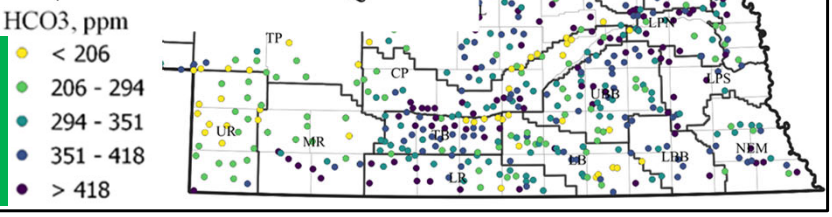


Bicarbonate and ag lime equivalent, eastern

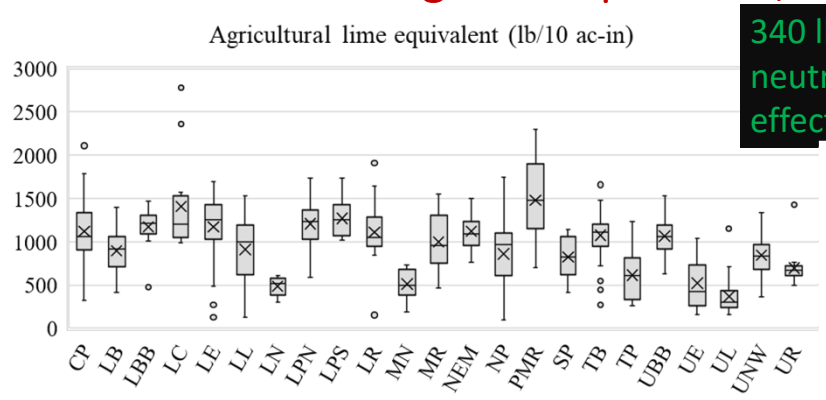


340 lb of agricultural lime neutralizes the acidification effect of 200 lb of fertilizer-N.

The liming effect of 10 ac-in was >340 lb ag lime for 86% of the wells, and nearly all outside the Sandhills; 50% with 5 ac-in.



Bicarbonate and ag lime equivalent, western



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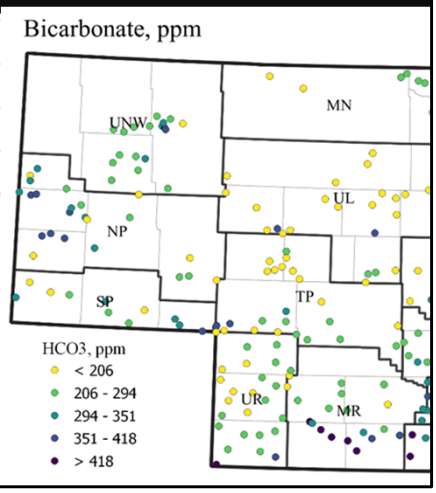
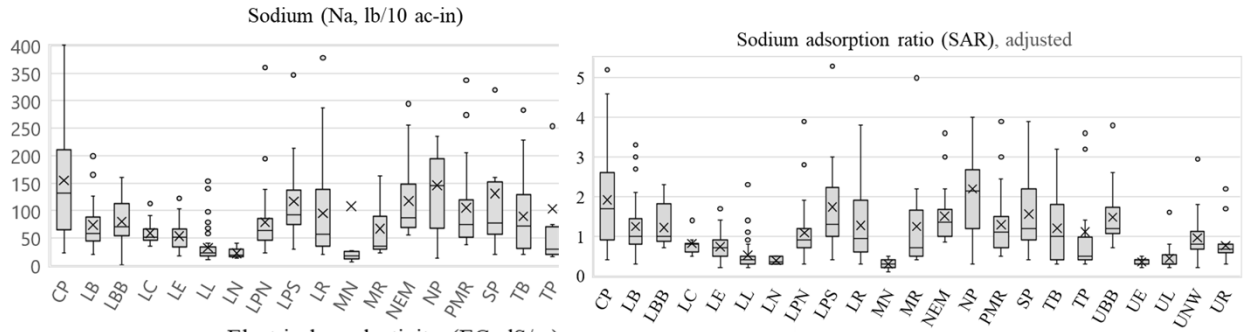
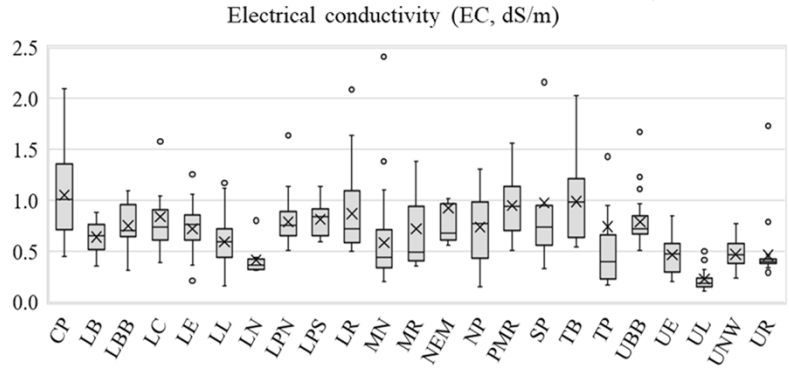


The liming effect of 10 ac-in was >340 lb ag lime for 79% of the wells (88% in 15 ac-in) and nearly all wells outside the Sandhills.





None of the sampled wells had problematic SAR but 2 of 642 wells had high enough EC to eventually cause excess soil salinity for corn and dry bean production.

Conclusions

- Irrigation supply in 10 ac-in > removal in 200 bu/ac of corn grain for:
  - Ca, Mg, S, and Cl with >50% of wells
  - K, Mn and Mo with >20% of wells
  - Zn, Cu, Fe, and Mo with few wells
  - liming neutralizes acidification by 200 lb of fertilizer-N for >90% of wells
- Most wells have < 4.4 ppm NO_3-N was but 25% >10 ppm
- Relatively low nutrient and lime supply for most Sandhills wells but high for wells of <100 ft depth
- Salinity and sodium of little concern **for the sampled wells**
- Test well water to optimize nutrient & soil management but continue to soil test and use UNL guidelines.

--Watch for detailed reporting in an Extension Circular
--A Journal Article In-Press
--Dataset Published

Thank you

Questions or comments?